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IS 11830-1 (1991): Water well-drilling down-the-hole hammer rigs, Part 1: General requirements for hydraulic rigs with or without rotary mode [MED 21: Diamond Core and Waterwell Drilling]



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भारतीय मानक

जल-कूप वेधन — नीचे छेद करने वाले हेमर रिग

भाग 1 द्रवचालित रिगों (घूर्णी विधि सहित और रहित) की सामान्य अपेक्षाएँ

(पहला पुनरीक्षण)

Indian Standard

WATERWELL DRILLING — DOWN-THE-HOLE HAMMER RIGS

**PART 1 GENERAL REQUIREMENTS FOR HYDRAULIC RIGS
(WITH OR WITHOUT ROTARY MODE)**

(First Revision)

UDC 622.233.4.055 : 628.112.24

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Diamond Core and Waterwell Drilling Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council.

This standard was first published in 1986 and this revision is based on the experience gained by the users and manufacturers organisations in implementing the standard.

This standard lays down the general requirements, for use as guidelines by the manufacturers and the users, for down-the-hole hammer hydraulic rigs. The requirements for pneumatic rigs are covered in IS 11830 (Part 2) : 1989 'Waterwell drilling down-the-hole hammer rigs: Part 2 General requirements for pneumatic rigs'.

Drilling techniques vary from formation to formation in construction of water wells. Of the various drilling techniques, down-the-hole drilling method is considered as most economical, faster and efficient in constructing tubewells in crystalline and hard rock formations. In hard rock areas, down-the-hole hammer drilling rigs have made considerable contribution towards the exploration of ground water and construction of domestic wells.

This standard is one of a series of Indian Standards relating to various types of drilling rigs. Other standards published so far in the series are:

IS 7156 : 1974 General requirements for reverse circulation drilling rigs

IS 7206 (Part 1) : 1986 General requirements for direct rotary drilling rigs: Part 1 With rotary table (*first revision*)

IS 7209 : 1974 General requirements for blast hole drilling rigs; and

IS 11830 (Part 2) : 1989 Water-well drilling down-the-hole hammer rigs: Part 2 General requirements for pneumatic rigs.

*Indian Standard***WATERWELL DRILLING — DOWN-THE-HOLE
HAMMER RIGS****PART 1 GENERAL REQUIREMENTS FOR HYDRAULIC RIGS
(WITH OR WITHOUT ROTARY MODE)***(First Revision)***1 SCOPE**

This Indian Standard (Part 1) lays down the general requirements for down-the-hole (DTH) hammer hydraulic rigs (with or without rotary mode) for water well drilling in consolidated formations.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

For the purpose of this standard, terminology as given in IS 9439 : 1980 shall apply.

**4 FUNCTIONS AND CONSTRUCTION
DETAILS****4.1 Functions**

This type of drilling rig is used to construct tube-wells for water supply and exploration purposes in hard rock formations. In down-the-hole (DTH) hammer drilling method, the hole is drilled by a bottom bit actuated by a pneumatic hammers connected to series of drill tubes termed as drill string. In this system compressed air, after passing through the drilling string, actuates the hammer. The hammer delivers successive blows at a high frequency to the bit which breaks/crushes the formation to smaller fragments. The cuttings so formed are brought out by the compressed air through the annular space. Along with compressed air, lubricating oil is also pumped for lubricating the various parts of the DTH hammer and other distribution valves. The whole string is rotated at a slow speed which can be varied depending on the formation while the hammer is actuated to deliver successive blows at high frequency. The rotating action of drill string with the impact action enables the down-the-hole hammer rig to drill through the hard rock formations for constructing a well.

4.1.1 The rigs may be provided with rotary drilling arrangements for negotiating softer overburdens, if required.

4.2 Constructional Details**4.2.1 Hoisting System**

4.2.1.1 Hoisting system consists of mast, top head rotary drive/top head rotation drive, pull down system, rod changing device and mast raising cylinders.

4.2.1.2 Mast

It serves the dual purpose of handling the drill rods, casing pipes and guide traverse of the top drive gear box. The mast shall be constructed either from steel conforming to IS 226 : 1975 or Grade A of IS 2062 : 1984 or steel tubes conforming to IS 1161 : 1979 and shall be capable of being lowered to horizontal position for easy transportation. All members shall be electrically welded with no cracks. The mast shall give clear working space and height to handle the drilling string and shall be able to accommodate the top drive mechanism and pull down system.

4.2.1.3 Top head rotary drive/top head rotation drive

The top head rotary unit shall be capable of producing enough torque to the drill string to drill to its designed capacity. Provisions shall be made for floating action of the rotary head for drill pipe thread protection and shock absorption. It shall be able to operate both at low and high speeds. The low speed varying up to 40 rev/min are used for DTH operations and higher ranges up to 100 rev/min are selected for rotary operations. The motor/motors used shall be capable of giving necessary torque required for the rated drilling capacity. It shall be very sturdy and shall be able to absorb sudden shock loads occurring during drilling operations.

4.2.1.4 Pull down/Pull back/Hold back system

The pull down/pull back/hold back system shall be provided to impart adequate load on the bit for efficient drilling and adequate power for lifting out the drill string from its rated depth. It also regulates the feed rate during drilling operations. This may be provided by hydraulically operated chain or cable.

4.2.1.5 Rod changing device

A device shall be provided for fast make-up and break-out of drill string keeping in view the operational safety and efficiency.

4.2.1.6 Mast raising cylinders

The raising or lowering of the mast to be carried out either by one or two mast raising cylinders. Adequate safety device through throttle check valve for accidental exigencies shall be provided.

4.2.1.7 Hydraulic jacks

Three or four hydraulic jacks of suitable capacity may be provided for quick levelling of the rig, designed to support the entire mass of the rig. A pilot operated check valve shall be provided for checking and preventing oil leakage from top side of cylinder.

4.2.1.8 Auxiliary hoisting system

Hydraulically operated auxiliary hoisting system of adequate capacity for handling sufficient number of drill pipes, casing pipes, and handling tools may be provided with the rig.

4.2.2 Hydraulic Break-out Wrench

This is provided on the rig for breaking of the drill joints or tightening the drill pipes as required.

4.2.3 Hydraulic System

In order to operate the different hydraulic equipment, one or more reliable hydraulic pumps of adequate capacity and pressure shall be mounted on the rig to be operated by suitable prime mover. The hydraulic pumps may be of gear, vane or piston type. Necessary spool valves may be provided for controlling the different hydraulic devices. Pressure gauges shall be installed to indicate the pressure used by the main system. Hydraulic system shall be protected by incorporating adequate capacity filters. A hydraulic oil cooler may be provided when considered necessary to prolong the life of the hydraulic oil and the system components to enable continuous working of the rig.

4.2.4 Compressor

The compressor of DTH rig shall be either mounted on the rig or carried on a separate trailer. The air pressure used shall be in accordance with IS 9242 : 1986 with an air delivery rate sufficient for efficient working of drilling. Regulating valves may be incorporated in the system for instantaneous supply and cut-off the air. Non-return valves shall be incorporated to prevent the loss of pressure and protect the equipment from back pressure. The compressor may be single/multi-stage, piston, rotary or screw type depending upon the operating pressure and air delivery ratings. The prime mover

of the compressor shall preferably be diesel operated engine of adequate capacity for continuous operation.

4.2.5 Air Line Lubricator

Air line lubricator of sufficient capacity to withstand the maximum working pressure may be provided to lubricate the various parts of the down-the-hole hammer tool and other rotary parts by injecting pressurized oil in the air system to prevent wear and tear of the parts of the hammer.

4.2.6 Water Injection Pump

Water injection pump of suitable capacity hydraulically driven, shall be provided for dust control and to help flushing of semi-moist clay or similar formation. The pump shall be capable of variable delivery of minimum 15 litres water per minute at pressure adequate to overcome the compressed air pressure for injection of water. Water with drilling foam may also be used.

4.2.7 Lighting System

The rig shall have provision for lighting system to illuminate adequately the entire rig and the working area for carrying out the drilling operations during the night.

5 CONTROLS

All the controls shall be located conveniently for maximum visibility and ease of operation.

6 MOUNTING

All the above units put together comprise one DTH unit. The whole system shall be mounted on a steel welded structure forming a welded foundation for the entire machinery. This structure in turn may be mounted on a self-propelled road worthy truck or suitable carrier of adequate capacity having sufficient wheel base, or on a trailer chassis with pneumatic wheels with tow bar arrangements for shifting by tractor or truck. The total length width and height shall conform to the statutory motor vehicles rules and regulations and other relevant orders.

7 ROTARY MODE

In case the rig is designed for mud rotary drilling operations also, a reciprocating or centrifugal type mud pump of adequate capacity with independent prime mover may be provided for carrying out the mud rotary drilling.

8 DRILLING TOOLS AND ACCESSORIES

A complete set of operating equipment and tools as specified in 8.1 to 8.5 may be provided as part of agreement between the purchaser and the supplier.

8.1 Drill Pipes

In case of DTH drilling, the drill pipes are used to transport the air for actuating the hammer tools and flushing out the cuttings as well as for imparting rotational motion. Larger diameter pipes are used for reducing the annular area thereby increasing the flushing efficiency and increasing the penetration speeds. The tool joints and the drill pipes shall conform to the specified requirements.

8.2 Down-the-Hole Hammers

The hammer tool is used to impart the necessary percussive motion to the bit for penetrating through the formation. The DTH hammer normally operates at 6 to 24 bar air pressure depending upon the capacity of the compressor provided with the rig. The hammer shall be able to deliver necessary blows at a frequency ranging from 600 to 1 600 per minute depending upon the compressor and hammer design. The hammers shall necessarily be provided with a check valve to prevent the water from entering into the hammer when air supply is shut off.

8.3 Bits

The down-the-hole hammer drilling rigs may be provided with required size of rock roller bits and button bits/cross bits to drill through the overburden. For drilling hard rock formations, suitable button, cross and reamer bits may be supplied with the rig depending on the capacity of the DTH drilling rig and the hammer supplied.

8.4 Essential Accessories

The following essential accessories may be supplied with the rig:

- a) Pencil bit grinder;
- b) Template;
- c) Fishing magnet;
- d) Bit detaching chuck;
- e) Centralizer half bushing (split design);
- f) Spanner for breaking the joint;
- g) Wrench for opening pipe drives;
- h) Wrench for opening hammer assembly;
- j) Bit breaker;
- k) Drill and handling tool;
- m) Dust control cover;
- n) All types of subs connecting the drill string;
- p) Recovery taps;
- q) C-clamps conforming to IS 9181 : 1988;
- r) Hoisting plug for drill pipe;
- s) High pressure delivery hose for compressor; and
- t) High pressure delivery hose for water injection pump.

8.5 Small Tools

The following small tools may be supplied with the drill rig:

- a) Pipe wrenches, of nominal size 150, 600 and 900 mm conforming to IS 4003 (Part 2) : 1986;
- b) Chain pipe wrenches conforming to IS 4123 : 1982;
- c) Grip wrenches;
- d) Pliers conforming to IS 3650 : 1981;
- e) Screws jack (s) of suitable capacity;
- f) Adjustable wrenches conforming to IS 6149 : 1984;
- g) Ring spanner set conforming to IS 2029 : 1981;
- h) Double ended open jaw spanner set conforming to IS 2028 : 1981;
- j) Box spanner set conforming to IS 2030 : 1971;
- k) Grease gun conforming to IS 7794 : 1984;
- m) Caliper set (inside and outside) conforming to IS 4189 : 1967;
- n) Scale conforming to IS 1480 : 1970 or to IS 1481 : 1970;
- p) Chisels conforming to IS 402 : 1974;
- q) Feeler gauge;
- r) Hexagonal socket keys conforming to IS 3082 : 1973;
- s) Hacksaw frame conforming to IS 5161 : 1986 with blade conforming to IS 2594 : 1977;
- t) Steel hammer conforming to IS 841 : 1983; and
- u) Wire rope clamps conforming to IS 2361 : 1970.

9 INFORMATION TO BE SUPPLIED BY THE PURCHASER

The following information shall be furnished by the purchaser at the time of enquiry and order:

- a) Geological history, in general, of the location of sites, and mean sea level (MSL), where holes are to be drilled;
- b) Maximum depth and diameter to be drilled;
- c) Mast height;
- d) Capacity of winch;
- e) Maximum size of casing to be lowered;
- f) Type of mounting (truck/trailor); and
- g) Any special features to be incorporated.

10 INFORMATION TO BE SUPPLIED BY THE MANUFACTURER/SUPPLIER

10.1 Following information shall be supplied by the manufacturer/supplier at the time of delivery:

- a) Type and capacity of drilling operations in respect of DTH and rotary system;
- b) Maximum diameter and depth that can be drilled by DTH and rotary system of drilling;
- c) Overall dimensions, front axle load, rear axle load, make and model of the chassis, wheel base in case of trucks, towing arrangement particularly in case of trailer;
- d) Air compressor : make, model, type of mounting, specified pressure, specified quantum of air delivered and type of cooling (see IS 6430 : 1985);
- e) Number of cylinders provided for raising mast;
- f) Number of hydraulic jacks provided for levelling and their capacity;
- g) Capacity of the hydraulic pump, its speed in rev/min, discharge and tank capacity;
- h) Prime mover capacity of the hydraulic pumps;
- j) Top drive mechanism: power ratings, torque capacity and rotational (rev/min) rating;
- k) Any special features for absorbing the drilling vibrations;

- m) Pull down system: capacity, chain feed or cable feed;
- n) Lifting capacity;
- p) Water injection system: discharge capacity and working pressure, type of prime mover;
- q) Air line lubricator, capacity and its working pressure;
- r) Drill rods: size and thickness of the rods, length of the rods, mechanical properties of joints and drill pipes;
- s) Hammer model and bit size;
- t) Sketch diagram of power transmission system;
- u) Recommended servicing system;
- v) Dimensions of the mast in down position such as overall height, length and width (see 6);
- w) Operating instructions manual and spare parts catalogue;
- y) Trouble shooting and remedy chart for all the major components; and
- z) Rating of houses

10.2 The above informations except informations at (u), (w) and (y) shall be furnished with tender documents.

11 TESTING

Testing shall be done as agreed to between the purchaser and the supplier.

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
226 : 1975	Structural steel (standard quality) (<i>fifth revision</i>)	3650 : 1981	Combination side cutting pliers (<i>second revision</i>)
402 : 1974	Cold chisels (<i>second revision</i>)	4003 (Part 2) : 1986	Pipe wrenches : Part 2 Heavy duty (<i>first revision</i>)
841 : 1983	Steel hammers (<i>second revision</i>)	4123 : 1982	Chain pipe wrenches (<i>first revision</i>)
1161 : 1979	Steel tubes for structural purposes (<i>third revision</i>)	4189 : 1967	Firm-joint inside and outside calipers
1480 : 1970	Metric scales for general purposes (<i>first revision</i>)	5169 : 1986	Hacksaw frames (<i>first revision</i>)
1481 : 1970	Metric steel scales for engineers (<i>first revision</i>)	6149 : 1984	Single-ended open-jaw adjustable wrenches (<i>first revision</i>)
2028 : 1981	Open jaw spanners (<i>second revision</i>)	6430 : 1985	Mobile air compressor for construction purposes (<i>first revision</i>)
2029 : 1981	Ring spanners (<i>second revision</i>)	7794 : 1984	Manual portable grease guns (<i>first revision</i>)
2030 : 1971	Box spanners (<i>first revision</i>)	9181 : 1988	C-clamps (<i>first revision</i>)
2062 : 1984	Weldable structural steel (<i>third revision</i>)	9242 : 1986	Rated pressures of air compressors (<i>first revision</i>)
2361 : 1970	Bulldog grips (<i>first revision</i>)	9439 : 1980	Glossary of terms used in water-well drilling technology
2594 : 1977	Hacksaw blades (<i>first revision</i>)		
3082 : 1973	Hexagonal socket screw keys (<i>second revision</i>)		

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